Menlo Park Notebook #172 [N-80-11-15]

This notebook covers the period October-December 1880. The entries are by Francis Upton. There is also one entry by Edison near the end of the book. The book contains notes, calculations, and a few drawings relating to lamp tests and to the wiring of the lamp factory. There are also notes and calculations regarding central stations, including estimates of costs and horsepower to be sold. In addition, there are notes, calculations, and a few drawings of isolated plants for the Vanderbilt home and for a building on 5th Avenue (probably the Edison Electric Light Company headquarters). The label on the front cover is marked "Upton" and "Calculations." The book contains 290 numbered pages.

Blank pages not filmed: 276-283, 286-287.

Jos Barris
C/o Wm Porters Sons
#271 Pearl St
N.Y.

LIBRARY OF THE
BOARD OF PATENT CONTROL,
120 BROADWAY, NEW YORK.
From Edison
GENERAL ELECTRIC.
44 Broad St. N.Y.
May 1, 1896

Graham The carbon in the clamp is estimated as being 3/16" long
0".102 wide
0".008 thick

for the two clamps this gives a cubical contents of cu in 0.0003

If this absorbs 7.5 it ~~weight~~ bulk in air

cu in 0.00225

2352—

3.3677
8.3536
2.1139

(3.8352

1.9176

82.7 volts

3.3677
~~7.8861~~
8.3536

~~9.6074~~

The globe of a lamp holds 15.5 CC.

.061

15.5
930

9.455

.00225) 9.45500 (~~4~~202
900
455
450
500

12 Oct 3-30 A.M.

~~# ~~2~~ 1 Blue [illegible] clasp~~

~~23~~

~~24~~

~~25~~

~~26~~

~~27~~

~~28~~

~~30~~

~~10 Blue 3~~

~~32~~

~~34~~

~~45~~

~~49~~

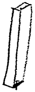
~~63~~

~~94~~

~~14 Blue~~

~~15~~

~~21~~



Let m = resistance of 1 inch
$0''.001 \times 0''.001$ square

R = Resistance of a body
$a \times b$ = cross section
l = length

$$R = \frac{l}{ab} m, \quad m = \frac{abR}{l}$$

Surface = S

$$S = 2(a+b)l$$

Problem to find the dimensions of a carbon which shall have the same surface and k times the resistance.

Same candle power

$R' = pR$

$S' = S$

$R' = \frac{l'}{a'b'} m = pR$

$S' = 2(a'+b')l' = 2(a+b)l = S$

~~Let~~

$l = g$ assumed

a' & $b' =$ unknown

$a'b' = \frac{gm}{pR}$

$b' = \frac{gm}{a'pR}$

$S' = 2\left(a' + \frac{gm}{a'pR}\right) g$

$$a' p R S' = 2 a'^2 p R g + 2 g^2 m$$

$$S = S'$$

$$2 a'^2 p R g - a' p R S = -2 g^2 m$$

$$a'^2 - \frac{a' p R S}{2 p R g} = -\frac{2 g^2 m}{2 p R g}$$

$$a'^2 - \frac{a' S}{2 g} = -\frac{g m}{p R}$$

$$a'^2 - (\ ) + \frac{S^2}{16 g^2} = \frac{S^2}{16 g^2} - \frac{g m}{p R}$$

$$a' - \frac{S}{4 g} = \pm \sqrt{\frac{S^2}{16 g^2} - \frac{g m}{p R}}$$

$$a' = \frac{S}{4 g} \pm \sqrt{\frac{S^2}{16 g^2} - \frac{g m}{p R}}$$

$$b' = \frac{g m}{a' p R}$$

If $\frac{g m}{p R} > \frac{S^2}{16 g^2}$

the result is impossible.

But if $\frac{g m}{p R} = \frac{S^2}{16 g^2}$ or $< \frac{S^2}{16 g^2}$

the problem can be solved.

$p = \frac{13}{16} = .812$

$$\begin{array}{r} 1.1139 \\ 1.2041 \\ \hline 9.9098 \end{array}$$

$m = 3966 = 4000$

$R = 175$

$S = 300$

$g = 4$

$p = \frac{130}{175} = .753 = \frac{3}{4}$

$$\begin{array}{r} 2.1139 \\ 2.2430 \\ \hline .8769 \end{array}$$

$$a' = \frac{S}{4g} \pm \sqrt{\frac{S^2}{16g^2} - \frac{gm}{\rho K}}$$

$$= \frac{300}{16} \pm \sqrt{\frac{90000}{256} - \frac{16000}{131.25}}$$

$$\begin{array}{r} 16 \\ 16 \\ \hline 96 \\ 16 \\ \hline 256 \end{array}$$

$$\begin{array}{r} 4\,\underline{)175} \\ 43.75 \\ 3 \\ \hline 131.25 \end{array}$$

$$\begin{array}{r} 4\,\underline{)75} \\ 18.75 \end{array}$$

$$\begin{array}{r} \cancel{4.9548} \\ \cancel{2.1931} \\ \hline 2.7611 \end{array}$$

$$\begin{array}{r} 4.2041 \\ 2.1179 \\ \hline 2.0862 \end{array}$$

$$\begin{array}{r} 122 \\ \hline 5 \end{array}$$

$$\begin{array}{r} \cancel{2)26580} \\ \cancel{1.3290} \end{array}$$

$$\begin{array}{r} 18.75 \\ 15. \\ \hline 33.75 \end{array}$$

$$\begin{array}{r} 4.9542 \\ 2.4082 \\ \hline 2.5460 \end{array}$$

40.55

$$\begin{array}{r} 352 \\ 122 \\ \hline 230 \end{array}$$

$$\begin{array}{r} 2\,\underline{)3617} \\ 1.1808 \end{array}$$

151

175
130 3/4 resistance

4/5 = 2/3 length

$$f' = \frac{gm}{a' pR}$$

$gm = 16000$
$pR = 130$
$a' = 15.1$

$$\frac{gm}{pR} = 122$$

$$\begin{array}{r} 2.0864 \\ 1.1790 \\ \hline .9074 \end{array}$$

$$\begin{array}{r} 8.08 \\ 33.75 \\ \hline 41.83 \\ 2 \\ \hline 83.66 \\ 4 \\ \hline 334.54 \end{array} \qquad \begin{array}{r} 17 \\ 8 \\ \hline 25 \\ 2 \\ \hline 50. \\ 6 \\ \hline 300. \end{array}$$

2.4771
1.3802
1.0969

~~12.5~~
12.5
4.47
8.03

36
16
216
36
576

4.9542
2.7604
2.1938

156

156
136
20

4.3764
2.2430
2.1334

1.3010
~~[illegible]~~
.6505

[illegible]
4.47

$g = 6$

$m = 3966$

$R = 175$

$S = 300$

$p = 1$

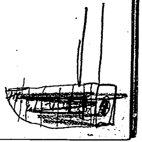
$$a' = \frac{S}{4g} \pm \sqrt{\frac{S^2}{16g^2} - \frac{gm}{pR}}$$

$$= \frac{300}{24} \pm \sqrt{\frac{90000}{16 \times 36} - \frac{23796}{175}}$$

$$\begin{array}{r} 3966 \\ 6 \\ \hline 23796 \end{array}$$

$= 8.03$
16.97

sli − 91



12730
2
2.5460

3966
4
15864

4.2004
2.1139
2.0865

351.8
122
229.8

2.3616.
1.1808

18.75
15.15
33.90

18.75
15.15
3.60

$$b' = \frac{gm}{a' \, p R}$$

4.2804
8.4698
7.8861
.5563.

3.6

$$a' = \frac{ss'}{4g} \pm \sqrt{\frac{s^2}{16g^2} - \frac{gm}{pR}}$$

$pR = R' = 130$
$m = 3966$
$s' = 300$
$g = 4$
$p = \frac{130}{175}$

$$a' = 18.75 \pm \sqrt{351.8 - 122}$$

33.9
3.6
37.5
2
75.0
4
300.0

$$\begin{array}{r} 1.0969 \\ 2 \\ \hline 2.1838 \end{array}$$

$$\begin{array}{r} 152 \\ 122 \\ \hline 30 \end{array}$$

$$\begin{array}{r} 1.4771 \\ \hline .7385 \end{array}$$

$$\begin{array}{r} 5.47 \\ 12.5 \\ \hline 17.97 \end{array}$$

$$\begin{array}{r} 12.5 \\ 5.47 \\ \hline 7.03 \end{array}$$

To change the surface

$S' = 200$

$$a' = \frac{200}{16} \pm \sqrt{\left(\frac{200}{16}\right)^2 - \frac{gm}{pr}}$$

$$a' = \overset{50}{12.5} \pm \sqrt{152 - 122}$$

$0''.007 \times 0''.018 \times 6''$

$pr = R'$

$$\begin{array}{r} .8751 \\ 2 \\ \hline 1.7502 \end{array}$$

$18''$

$$S' = 300$$

$$g = 10$$

$$m = 3966$$

$$pr = R' = 300$$

$$a' = \frac{S'}{4g} \pm \sqrt{\left(\frac{S'}{4g}\right)^2 - \frac{gm}{pR}}$$

$$\frac{300}{40} = 7.5$$

17
8
136

2.1335
2.1614
6.2218
.5167

3.286

$S = 2(a+b)l$

17
8
25
2
50
6000
300 000

Lamp No. 67 of Lot 2
giving 16 candles ~~and~~
with a resistance of 145 Ohm
This lamp was made ~~of~~
the best bamboo ~~that~~ has
yet been found — Mr. B.
said that it was absolutely without pith.

All linear measurements in 0".001

$l = 6000$

$a = 17$

$b = 8$

$R = \frac{l}{ab} m$

$S = 300\,000$

$R = 145$

$m = \frac{abR}{l} = 3.286$

$$\begin{array}{r} 1.0969 \\ 2 \\ \hline 2.1938 \end{array} \quad 15.6$$

$$\begin{array}{r} 4.1189 \\ 2.1614 \\ \hline 1.9575 \end{array} \quad \begin{array}{r} 156 \\ 90.7 \\ \hline 65.3 \end{array}$$

$$\begin{array}{r} 1.8149 \\ \hline .9074 \end{array} \quad 8.08$$

$$\begin{array}{r} 12.5 \\ 8.08 \\ \hline 4.42 \\ 20.58 \end{array}$$

---

page 11

$$a' = \frac{S'}{4l'} \pm \sqrt{\left(\frac{S'}{4l'}\right)^2 - \frac{l'm}{R'}}$$

$S' = 200000$
$l' = 4000$
$m = 3.286$
$R' = 145$

$$\begin{array}{r} 3.286 \\ 4000 \\ \hline 13\ 154.000 \end{array}$$

$$\frac{\overset{100}{\cancel{200000}}}{\underset{8}{\cancel{16000}}} = 12.5$$

$a' = 20.58$
$b' = 4.42$

$$\begin{array}{r} 25.00 \\ 2 \\ \hline 50.0 \\ 4 \\ \hline 200 \end{array}$$

O.K.

4.1189
2.1461
1.9728

156
~~9.39~~
93.9
62.1

1.7931
.8965

12.5
7.88
4.62

4.1189
2.1303
1.9886

20.38

156
97.4
58.6

1.7679
.8839

12.5
7.65
4.85
2013

4.1189
2.1139
2.0650

156
101
55

1.7404
.8702

12.5
7.42
5.08
19.92

Same values as on page 29
except R' = 140

a' = 20.38
b' = 4.62

R' = 135
a' = 20.15
b' = 4.85

R = 130
b' = 5.08
a' = 19.92

4.1189
2.0969
2.0220

2 | 1.7076
.8538

156
105
57

12.5
7.14
5.36
19.64

4.1189
2.0792
2.0397

| 1.6721
.8360

156
109
47

12.5
6.86
5.64
19.36

4.1189
2.0414
2.0775

| 1.5611
.7805

156
119.6
36.4

12.5
6.03
6.47
18.53

R = 125

a'' = 19.64
b' = 5.36

R = 120
a' = 19.36
b' = 5.64

R = 115

R = 110

a' = 18.53
b' = 6.47

156
131.5
24.5

1.3892
.6946

12.5
4.95
7.55

4.1189
1.9542
2.1647 12,5

156
146
10

3.16
9.34
15.66

$\frac{gm}{pR} = \frac{\delta^2}{16g^2}$ $\frac{lm}{R'} = \frac{S^2}{16l^2}$

$\frac{16l^3m}{S^2} = R'$

5,3010
16.6020

4.000
4.000
16.000
4
64 109
16
384
64
1.024

~~11.4937~~
10.6020
12.5269
10.6020
1.9249

3.0103
0.5166
~~2.4937~~
9
~~11.4937~~

3.5269
3.9/12

R = 100
a' = 17.45
b' = 7.55

R = 90
a' = 15.66
b' = 9.34

R = 84.1
a' = 12.5
b' = 12.5

2.3010
1.2553
11.0457
2
2.1914   123.5

D.5766
3.6532
4.1698   147.80
2.1614
2.0084   123.5
102
21.5

1.3324
.6662   11.1
4.64
15.74
6.46

4.1698
2.1761
1.9937   123.5
98.6
24.9
1.3962   11.1
.6981   4.99
6.11
16.09

$l = 4500$

$$\frac{4500 \times 4}{18000}$$

$S' = 200000$

$m = 3.286$

$R' =$

$$a' = \frac{s'}{4l'} \pm \sqrt{\left(\frac{s'}{4l'}\right)^2 - \frac{l'm}{R'}}$$

$$\frac{200000}{18000} \qquad 11.1 \pm \sqrt{123.5 - \frac{147.80}{R'}}$$

$R' = 145$

$a' = 15.74$

$b' = 6.46$

$R' = 150$

$a' = 16.09$

$b' = 6.11$

4.1698
2.2141
1.9657

1.4928
.7464

123.5
92.4
31.1

11.1
5.58
5.52
16.68

4.1698
2.2304
1.9394

1.5623
.7811

123.5
87.
36.5

11.1
6.04
5.06
17.14

4.1698
2.2553
1.9145

1.6160
.8080

123.5
82.2
41.3

11.1
6.43
4.67
17.53

R = 160

a' = 16.68
b' = 5.52

R = 170

a' = 17.14
b' = 5.06

R = 180
a' = 4.67
b' = 17.53

4.1698
2.1461
2.0237

123.5
105.5
18

1.25553
.6276

11.1
4.24
6.76
1534

4.1698
2.1303
2.0395

1.1461
.5730

123.5
109.5
14.0

11.1
3.74
7.36
14.84

4.1698
2.1139
2.0559

.9956
.4978

1235
11.36
9.9

11.1
3.15
7.95
14.25

140 = R
a' = 15.34
b' = 6.76

R = 135 Ohms

a' = 14.84
b' = 7.36

R = 130 Ohms

a' = 14.25
b' = 7.95

4,1698
2.0969
2.0729

12.35
11.83
.5.2

.7160..
3580

11.1
2.28
8.88
13.38

4.1698
2.0792
2.0906

123.3

$$R' = \frac{16\,l^3 m}{S^2}$$

3.6532
3
10.9596
1.2041
0.5166
4.6998
4.6990
22.0783

2.0783

R = .125

a′ = 13.38
b′ = 8.88

R = 120

a′ =
b′ =

R = 119.7 Ohms

a′ = 11.1
b′ = 11.1

$\mathcal{L} = 10000$

$S = 200000 \quad m = 3.286$

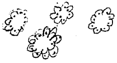
$R = 250$

$$a' = \frac{S}{4l} \pm \sqrt{\left(\frac{S}{4l}\right)^2 - \frac{l^2 m}{R}}$$

$$\frac{200000}{40000} = 5 \pm \sqrt{25 -}$$

$a + b$

ab



$a+b : a'+b' :: R' : R$

$$R' = (a+b)\left(\frac{R}{a'+b'}\right)$$

$S = ab$

$ab : a'b' :: S : S'$

$$S' = \frac{a'b'S}{ab}$$

$$\begin{array}{r} 17 \\ 8 \\ \hline 136 \end{array}$$

$$\begin{array}{r} 12 \\ 12 \\ \hline 144 \end{array}$$

$144 : 136 :: X : 165$

$$\begin{array}{r} 2.1584 \\ 2.2175 \\ 7.8665 \\ \hline 2.2424 \end{array}$$

1749

$$\begin{array}{r} 17 \\ 8 \\ \hline 136 \\ 145 \end{array}$$

$$\begin{array}{r} 2.1335 \\ 2.1614 \\ \hline 4.2949 \\ 2.1584 \\ \hline 2.1365 \end{array}$$

19700

$a+b : a'+b' :: S : S'$

$$S' = \frac{(a'+b')\,S}{a+b} \qquad L = \text{Constant}$$

$ab : a'b' :: R' \; R$

$$R' = \frac{ab\,R}{a'b'}$$

$L = 6000 = L$

$S = 300$

$a+d = 25$

$a = 17$

$b = 8$

$R = 145$

$a = 16$

$b = 9$ $\quad R = 137$

$$\begin{array}{r} \\ \hline 144 \end{array}$$

4.2949
2.1761
2.1188

4.2949
1875
.1074

2949
1931
1018

2949
1004
1945

12.5
12.5

2949
1938
1011

.0969
5
1938

2949
0569
2380

a' = 15
b' = 10
150

131 Ohms

a' = 14
b' = 11
14
14
154

128 Ohms

13
1.2
26
13
156

12.5 = a
12.5 = b

127 ohms
126.3 Ohms

18
7
126

157

19
6
114

173

20
5
100

197

1.0174
2
2.0348

2949
0348
2601

2949
0269
2680

2949
0111
2838

2949
9859
3090

2949
9494
3455

2949
8984
3965

6" carbon l = 6000

250 surface S = 250000

~~300~~ 6 : ~~250~~ 5 :: 12.5 : X

5

6) 62.5

10.416+

10.416

20833

182 Ohms

11.83
9.
106.47

185.4

12.83
8.
102.64

192.1

13.83
7.
9681

~~204~~

203.8

14.83
6.
88.98

224.5

15.83
5.
79.15

249.2

9202
2
1.8404

2949
8404
4545

2949
8203
4646

2949
8061
4888

2949
7659
5290

6" carbon   l = 6000
200 Surface   S = 200000

300 : 200 : 12.5 : X
2
3 ⟌25.
X = 8.33

a = 8.333
f = 8.333   284.7

9.666
8
67.666   291.5

10.666
6
63.999   308.1

11.666
5
58330   338.

15
15
75
15
225

$Q = \frac{l}{ab} m$

3.6990
~~7.1031~~
6.5166
~~1.3187~~

~~206~~

7.6478
1.8634

73

2.3522
4.2156
2.3502
8654

2156
3444
8712

2156
3345
8811

5'' Carton

$l = 5000$

~~a~~ $\delta = 300000$

$5000 \overline{)300000}$
160
75

$s = 2(a+b) l$

$a = b$

$4a^2 = \frac{s}{l}$

$a = \frac{s}{4l} = 15$

$a = 15$
$b = 15$

73 ohms

16
14
64
16
224

73.3

17
13
51
17
221

74.3

18
12
36
18
216

76.

2156
3201
8955

2156
3010
9146

2156
2765
9391

2156
2455
9701

2156
2068
9088

2156
1584
0572
2156
0969
1187

19
11
19
19
209

78.6

20.0
10
200

82.5

21
9
189

86.9

22
8
176

~~117.5~~
93.3

23
7
[illegible]
161

102

24
6
144

114.1

25
5
125

131 Ohms

Length 5'' [illegible] $l = 500$

Surface $= 250 = S = 25000$

$$S = 2(a+b)l$$

$$R = \frac{l}{ab}\,m$$

$a = b$

$S = 4al \qquad a = \frac{S}{4l}$

$$\frac{25\cancel{000}}{2\cancel{000}} = 12.5$$

2.0414
2.0414
1.6464
7.7930 5.7292
3.5222 3328
1.0792
2.4430 277

33000 4.5185
2.4430
2.0755 119

3.2 : $\frac{8}{3.25}$ :: 150

$\frac{8}{3.25}$

3.2
65
675
5

16
Lamp 153 Ohms at 16 candle

110 Volts on line.

12 candles
154.5 Ohms 105.5 Volt

105.5 : 110 :: 154.5 :

2.1889
2.0414
7.9767
2.2070

161. ohms
154.5
6.5 Ohms

3~~500~~ 800
~~3200~~
~~12~~ 3

266

5.7292
2.7637 2355
3.4929 (3110
388

4.5185
2.5888
1.9297 8(85 candles per HP.
10.

5.7292
2.2926
3.4366 4(2730
682

4.5185
~~[illegible]~~
~~1.5730~~ (~~37~~
~~2.9455~~
~~4.5185~~ 4
4.5185
2.8338
1.6847 (48.8
12.2

8 candles

156.7 Ohms
100 Volts

100 : 110 :: 156.7
1567
172.37
156.7
15.6 Ohms

---

4 candles

161 Ohms
~~1513~~ Volts
90.3 : 110 :: 161
161
17710

4.2483
1.9557
2.2926

19.6
161
35 Ohms

166 Ohms

82.6 ; 110 ;; 166

166

18260

4.2615

1.9170

2.3445

221

166

55 Ohms

5.7292

2,3445

3.3847

2435

1217

4.5185

3.0856

1.4329

27

13.5

Lamp 6" X 0".012 X 0".012

16 candles 110 Volts

.115

3.14

$$\begin{array}{r} \bar{1}.0607 \\ 0.4969 \\ \hline \bar{1}.5576 \end{array}$$

·361

Central Station (1)

Estimate for 10000 lamps fed from a central station each giving 16 candles

It is found that 8 of these may be obtained ~~of~~ from one horse power indicated

Say that a gas burner giving 16 candles consumes 5 feet of gas an hour for comparison

200 hours for 1000 feet or 10000 lamps will consume 5,000 feet an hour

Call $1 in electricity an equivalent of a 1000 cu.

feet of gas an M (1)

50 M an hour

250 M a day

310 days in year in the district chosen

310
250
15500
62
77,500 Mcu. feet a year

Old estimate
$159.300 invested

5.2022
4.8893
.3129

$2.05 investment per M.

at 8' per H.P. 10000 (1)
lamps will take 1250 H.P.
It is estimated that
1200 H.P. will be able to supply this amount.

This can be placed in one building 25' X 100'.

The iron structure is estimated in Book 100 p. 50

120.000 lbs of iron.
.05

$6000.00	$6.000
Foundation	2.500
Fire proof floors	2 000
	18,500

Boilers 600 H.P (1)

Babcock and Wilcox estimate, see letter.

600 H.P. boiler in place with economizer	$12,875
Stack	800
Steam pump	375
Blowers,	300
Engine with counter-shaft	650
Piping	165
Ash elevator	400
Coal bunker	800
600 H.P.	$16365

1200 H. P. Boilers (1)

Complete Boilers	$ 24,500
Stacks	1600
Steam Pumps	750
Blowers	600
Dynamos for Blowing	1000
piping	330
Ash Elevator	400
Coal bunker	1000
	$30180

Engines Dynamos (1)

Mr. K. estimates cost at —

$4800
10
48000

Extra Electrical apparatus
$2000

lbs of H_2O in one Gall
= .16 Cu ft

7959 6.25 Galls in Cu ft

6.25
10
62.5 lbs in Cu. ft.
100
6250 lbs. for 7.5 cts

.8779
3.7959
$\bar{3}$.0820 .0012

.0012 cts per lbs
30
.0360 cts per hour per H P.

Total

Building 8500
Boilers 30180
Engines Dynamos 48000
Extra Electrical 2000
88.680
2000
90680
Conductors $27 000
1750 Ohm lamp 30 000
Pipes
$57 000
88 680
145,680
Meters 5 000
150 680
2000
152,680

85

57600
.03
1728 00

48000
.03
1440.00

365
20,5
1825
730
7482,5

365
20,5
1825
730
7482.50

Depriciation

Station

Boilers	10%	$ 3018
Building	2%	170
Engines Dynamos	3%	1440
Extra Electrical	[illegible]	40
Meters	5	250

Conductors

2% in whole	57000 .02 114.000	1140
		6058.

365
5
# 1825

Labor

1 Engineer, chief			5.00
1 Engineer			3.00
1 Wiper	@	1.50	1.50
1st Fireman	@	2.25	2.25
1 Fireman	@	1.75	1.75
2 Laborers	@	1.50	3.00
1 Regulators	@	2.25	2.25
1 Regulator	@	1.75	1.75
~~assistant~~			20.50
			365
Year			7482

Data

$200 per H.P. per year

delivered

Present machine cost $350.
good for 70 lamps

Conductors copper	27 000
Pipes	25 000
Insulation	5 000
	$ 57 000.

The labor account is taken thus a chief engineer who will be on duty from 12 M to 12 midnight an assistant who will be on duty from 12 midnight to 12 M. a wiper who will be on duty from 7 a.m to 7 P.M.

One fireman @ $2.25 who will be on duty from 12 M to 12 midnight

One fireman @ $1.75 who will be on duty from 12 midnight to 12 M

One laborer from 7 am

(1)

to 7 P.M another from 12 P.M to 12 midnight. One regulator @ $ 2.25 from 12 M to 12 midnight one @ $1.75 from 12 midnight to 12 M.

Thus the cheif engineer will be on duty during the most important part of the day, and the wiper will be under each of the engineers. The head fireman will also be on duty and have ~~between~~ 5 & 6 P.M two laborers. This system will offer a good chance for promotions

365
365
391 5.

22.40) 18000 (8.03
17920
8000.

8.03
28
6424
1606
22.484

22.5
365
1125
1350
675
8212.5

daily

---

(1)

Executive expenses

Year $4000

Coal

$2.80 per ton delivered

3 lbs per H.P. per hour

1200
3
3600 lbs per hour
5
18.000 lbs per day

8.03 tons per day

$22.50 daily

$8212.5 year

150000
.02
300000

Lamps

30000 yearly
.35
30000
10,50000

Oil, waste, water taken
as 1/3 coal
Yearly $ 2737.

Rent insurance Taxes $ 7.000

Summary

Depreciation	$ 6058
Labor	7,482
Executive	4,000
Coal	8.212
Oil-waste &c	2737.
Rent &c	7000
	$ 35489.
Lamps	10,500
	45.989

152.7) 15933 (104
1527
6600

346
1693

152600
76300
229020

9125) 45740 (50
45625
00115

Cost 50 cts per M

136875
68437
205312

91250
225
45625
18250
18250
205312.5

If 10000 lights can be sold for 5 francs daily & it is equivalent to 250,000 ~~Cu. feet of~~ Cu feet gas.

365
250
18,250 ~~Annually~~
0.730
91250
1.50
456.2500
9125
Receipts 136875.00
Expenses 45989
$90.886 [illegible] to pay for patent rights and interest

1527) 90845 (59
7635
14490
13743
7470

301.3) 9088 (30%
9039
49

---

(1)

If company capitalizes at twice the cost of plant

$ 150680
2
301,360

The receipts will pay a dividend of 30 per cent.

60% on investment.

72) 72

Now for estimate under worst conditions and giving all margins.

6 per H.P.

2½ hours a day

Machine for 72 lights to cost ~~twen~~ $500

Belts &c 100

Building ~~double~~ ½ again as ~~as~~ much ~~again~~

219 hours per lamp

Conductors $80,000

Coal $5.00 per ton

1200 H.P.

7200 lights

Investment

Structure	10500 5258 15750	$ 15.950
Boilers		30.180
Engines		24,000
Dynamos	100	50,000
Belts &c		10 000
Conductors		80 000
Extra Elec		2 000
Meters		5 000
		216930

12750
.02
255.00

Worst,

Depreciation

Structure	2%	$ 315
Boilers	10	3018
Engines	3	720
Dynamos	3	1500
Belts	5	500
Conductors	2	1600
Extra Elec	2	40
Meters	5	250
		$ 7943

Labor	$ 7482
Executive	4000
Coal	8796
Oil waste &c	2932
Rent &c	10000
Lamps	10 500
	$ 51653

Five hours use

all items expense same except Coal & water
& Lamps

51653
Coal &c 8796
2932
$ 63381
Lamps 10.500
73881

Receipts

49.275
2
98550
73881
24669 profit

Coal

Is taken as three hours
daily to supply 2 1/2 hours
1200 H.P.
9 lbs per H.P. per day

2240) 10800 (4.82 tons
8960
18400
17920
4800

say

4.82
5
24.10
365
1205
1446
723
$ 8796.50 yearly

2089) 547.0 (2.6

4178

1292

~~547~~

208.9) 1710.0 (8.2

1671.2

4880

∴ 8.2 % on investment

at $140 for M

2090) 5135 (2.4

4180

9550

208.9) 8550 (4.0

8356

1940

Receipts ~~1/2~~ of page ~~97~~

2 1/2 hours ~~3~~ hours

136.875 136.875

$68.437 51.303

51.303 85.572

$17.134 = 40% of five hours

~~208~~ 10 % on investment

6.6 % on investment

1 watering 1/2

at $225 to compare with

gas line

68.437

34.219

102.655

51.303

51.352

24% on investment

(2) Receipts

7200 lamps
.2.5 hours
36000 0
144
180 000 per hours to lamp
5
90,0 00 cubfeet daily
365
90
32850
$1.50 per M M
1642500
32850
49,275.00

At $2.25 the present price of gas in N.Y.

7200)300000 (41
288
120

180000
365
90000
108
54
3000)657000
219 hours per lamp

Costs 51653
Receipts 49.275
Loss $2378

49.275
24637
73912
51303
$ 22609 or 16% on capital,

See page 106 for five hours use same lamps

With present plant (3)

6 per H. P. indicated

1200 Horse power

7200 lamps

3 per year

Coal $2.80 per ton at station

Building ½ again as much

Conductors $57.000

Five hours use a day

Investment

Structure	15 750
Boilers	30,180
Engines	24 000
Dynamos	35 000
Conductors	57 000
Extra Elec	2 000
Meters	5 000
	$168,930

7200
3
21600
.35
108000
64800
7560.00

(3)

Depreciation

Structure	2% p105	$ 315
Boilers	10%	3018
Engines	3	720
Dynamos	3	1050
Conductors	2	1040
Extra Elec.	2	40
meters		250
		6633
Labor	p. 85	7,482
Coal	p 93	8,212
Oil &c		2,737
Rent & taxes		10,000
Executive		4,000
		39,064
Lamps		7560
		$ 46624

Receipts.

page 110 $49.275
2
98550
46624
$ 51,926.

168.9) 51,92 (30
5067
1250

$1,50 per M

30% on investment

75)10000(134
75
250
225
250

(B)

1500 H. P.
10000 Lamps
6.6 per H. P.
134 Machines 75 lamps @ $350
134 Belts ~~[illegible]~~ @ ~~50~~
Average use five hours
Lamps costing 35 cts.

134
75
6~~9~~70
~~9~~ ~~2~~ 8
~~9900~~
10050

134
350
670.0
~~4~~ ~~0~~ 2
46,900

132.00
66.00

Investment (B)

Structure		15,750.00
Boilers	30000 7545 37725	37,725.00
~~[illegible]~~		
Engines	24000 6000 30000	30,000.00
Belts		6700.00
Dynamos		46,900.00
~~Electrical~~ Testing Apparatus		3000.
Conductors		57000.
Meters		5000.
		202075.

46900
.03
1407.00

3.65
150
18250
365
547.50
7482.
8929 50

18212
2053
10265

Expense

Depreciation

Structure 2%	210 105 315	315
Boilers and accessories 10%		3772
Engines 3%		900
Belts 10%		670
Dynamos 3%		1407
Testing apparatus 2%		60
Conductors 2%		1140
Meters 5%		250
		$8,514.
Labor		8029
Executive		4000
Coal		10265
Oil &c		3422
Rent Insurance &c		10000
Lamps		10500
		54,730

202,1) 150,6.0 (74
14147
9130

202075
101037
303112

74
24
50

202.1) 82,15 (40.6
80 76
13900
114

41
14
27

202

Income (B)

$2.25

205,312
54,730
$ 150,582

74% on investment of $202,075

Investment increased 50% for patent rights $303112

50% on investment

$1.50 Income $136,875
54,730
$82,145

41% on investment

27% on investment increased 50% to $302,962

Power

1 Horse power at 8 lamps per H.P. furnishes 40 feet an hour or takes 25 hours to make 1000 cu. feet

6 cts an hour per H.P.
at $1.50 per M this is 6 cts per hour per H.P.

100 H.P. 10 hours daily

112 0.5 5
100160
.342
3463

70

27

8212.50
2737.50
1095000
2190
8760

8212
1642
6570

10,500
2100
8400

60
266
534

65695
21905
87600
21900
109500

205,212
41.062
164,250

152,680) 122,510 (80
122144
3660

15.27) 67.76 (43
6308
4680

164250
54750
109500

Estimate A modified to (C)
four hours a day

Same plant $152,680

Same depreciation &c, Same Expense except coal, oil, &c 1/5 less

35530,50
2190
33340 50
8400

Lamps 1/5 less

41,740 50

$2.25

Income 1/5 less

164,250
41,740
$ 122,510

80 % on capital
53 % on watered stock

109500
41,740
67,760

$1.50

43 %

29 % on watered

7)1200
7
8400

7)~~12000~~ 1
1714

1200
7
8400 lamps
$

365
4
1460 h
8400
584000
1168
4)122640~~00~~

30,660
.35
153300
91980
10731.00

8)10000
1250
8750

Estimate A modified ($\overset{a}{D}$)

four hours a day
7 per H.P.
lamps last 400 hours

Same plant as (A) $ 152,680

Same coal Depreciation as (C) 33,340.5
lamps 10,731
44,071.5

Est-A, mod, To ($\textcircled{T}^{\beta}$)
400 ⓐ
see Page H/157

8400 lamps
4 hours 2 feet

33600
5
168000
~~365~~
[illegible]
1004
10920

365
168
2920
2190
365
61320
1.50
306600
61320
$ 91,980.00

lamps
8400 (1.50)
4
336.00
168[illegible]

61,320
225
306600
122640
122640
~~306600.00~~
137970.00

~~Income~~

$1.50

91,980
44,071
47,909

152,680)47,900(31% on investment
45804
21[illegible]60

20% on watered plant.

$ 65,429.00 ✓

$152,680.00

1200 H.P.
3
3600 lb hour
4
14400 day

365
14400
146000
146
365
2240) 5256000 (2346 tons year
4480
776
672
1040
896
1440

2346
3.5
11680
7008
$ 8176.00

Coal

2737
91.2
$ 1,825
8,176
10,001
8,760
1,241

2340
3.50
11700
7020
$ 8,190.00
Coal

8190.00
1825.
10,015.00

Same as D 7per H.P 4 hours (E)

Except coal $ 3.50 per ton

Conductors $ 75,000 400 hours life

Depreciation on conductors 3%

75000
57000
18000

152,680
18000
Investment $ 170,680.

Depreciation 3% on 75000
3
225000
1140
$ 11,10.00
1241.
33340.5
35691.5
10731
$ 46,422.5

More than D
" " D

6098
1110
7208

16569.50
164237
8217.87

365 days
4 hours

1,460 hours
~~84,000~~

58 4000

1168

)12264 ~~000~~

61320
2.25

306600
12264
12264

1379 7000

11200
7

8400

---

*

Income same as (2nd)

91,880
46,422

45.458

1707)45.46(26.5 %
3414
11320
10442
8780

on $170.680

18% on watered stock

$85,340. for Patent Rights

365

Lamps 1/7 less

10731
1522 1533
9209 9198

1200
6
7200

365
4
1460
7200 lamps
2.92800
.10220

400) 10,512,000
26,280
35
13140.0
7884.0
9198.00

Present system 1200 H.P.
6 per H.P.
400 hours life
$75.000 in conductors
on which 3% depreciation

4 hours average use

$3.50 per ton for coal

Investment 202.075
18000
Conductors add $ 220075

Expense except lamps same as (E)
$35.691.5
Lamps 9209
$ 449005

$2.25 per M

78757
39378
118,135
44900
220) 73,235 (33.3 % on investment
66
72
66
63

22.2 % on watered stock

1/7 | 61,320
52,560,000 cu ft =
2,25 per m
118,260.00
41.269,00 Expenses
76,991.00 Net Income

---

(7)

Receipts 1/7 less than (2)1

78840
39420
11 | 8260

191.880
13140
78849
44900
33857

220) 33,8 (15.4 % on investment
220
1180
1100
800

$ 220.075

$ 110.000 for ~~Patent~~ Right

10.2 % on watered investment

202075 / 76,991 00
38 %

200 H.P. in Power sold
daily 10 hours

2000 H.P. one hour

Bark 1 Hand Powers 34
each may be counted as bringing
10 cts. per day Mr Kinney say
1 H.P. 6 cts. an hour
10 hour
60 cts

Count each as 1/4 H.P.

8 ½ H.P.
33
2.50
5
3
14
7.5
9
7
9
5

70 83 H.P. to rent

70
7 Horse

77 Horse power in Book
1 under 5 horse each.

Book 2
12 sewing machines
1/6 H. P
= 2 H.P.
.16
1 ~~[illegible]~~
.75
50
50
25
6 00
11.16 H. P

77
11.
12
74

174 H.P. in four books

Book 3

32 Hoists each 1/5 H.P.

6.4 H.P
1,5
1.
2

10,9 H P
1.

11,9

Book 4

77 Hand powers

14 H.P.
60 Estimation Counted

74 HP.

)152,680.00)852,238.25(

300 H.P. at least for
Ten hours
600 H.P for 5 hours
1200 H.P. for 2 1/2 hours
all the plant 2 1/2 hours

87,600,
150
438000
87600
$ 91,980.00

~~Est-(I B)~~

~~Page 131~~

~~Since the life of 1 lamp is 400 hours which at 5 hours per day's use is equivalent to 80 days duration.~~

~~And, since 5 cu ft per hour is the equivalent of 1 light or 25 cu ft per day then the life of 1 lamp would be equivalent to 2000 cu ft of gas and with 43,800 lamps would represent an equivalent of 87,600,000, cu ft of gas~~

~~365 d~~
~~5 h~~
~~1825~~
~~9600~~
~~1095000~~
~~16425~~
~~17520000~~

~~H.P.~~
~~1200~~
~~8 per HP~~
~~9600~~
~~400) 17520000 (~~
~~43800~~
~~lamps used per year~~

33000 4.5185
4312 3 6347

7.65 .8838
22 1.3424

2.2262

168 candles per H.P.

33000 4.5185
3535 3.5484

9.3 .9701
1.0792

2.0493

112 candles

Calculation for House wire

16 candles 128.4
15 127.2

1.2 Volts

for a candle

1% of resistance in conductors

150 Ohm lamp.

1.5 Ohms

50 feet 1.5 Ohms

24.8
12.4
37.2

256 : 340 :: 37.2 :
34.0
8

49.4 feet

1.5705
2.5315
7.5918
1.6938

Copper pure

Wire 1 ft. long 0".001 diameter having a cross section of one circular mill.

9.718 Ohms

97 : 100 9.718 Ohms 10.2 Ohms

$$R = \frac{l'' \times 10.2}{\text{Cross section.}}$$

$$\text{Cross section} = \frac{l \times 10.2}{R}$$

$\frac{l}{2} = 25$ $R = 1.5$
$l = 50$

$$\text{Cross section} = \frac{\overset{10}{\cancel{50}} \times \overset{3\times 4.}{\cancel{10.2}}}{\underset{.3}{\cancel{1.5}}} = 340$$

$l = 100$ $\frac{l}{2} = 50$

Cross section = ~~102~~ 680

$l = 150$ $\frac{l}{2} = 75$

Cross section = a = 1020

Wire 1 ft long 0".001 in diameter

12 × 0".001

1000 feet of wire

0".010 in diameter weighs

0·3026 lbs.

0".001 in diameter weighs

.003026.

1 foot weighs

.000003026 lbs
340
25 feet

.0257 lbs
2 wires

.0514

$\bar{6}$ 4808
2 5315
1 3979

$\bar{2}$·4102

$l = 200 \quad \frac{l}{2} = 100$

$a = 1360$

$l = 250$* $\quad \frac{l}{2} = 125$

$a = 1700 \quad \frac{l}{2} = 150$

$l = 300$

$a = 2040$

$l = 350 \quad \frac{l}{2} = 175$

$a = 2380$

$l = 400$* $\quad \frac{l}{2} = 200$

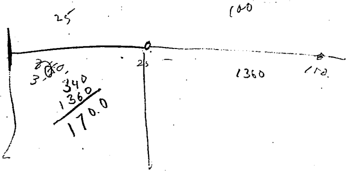
$a = 2720$

$l = 450$* $\quad \frac{l}{2} = 225$

$a = 3060$

$l = 500$* $\quad \frac{l}{2} = 250$

$a = 3400.$



~~Ohio~~

2 Ohio
3400
3364

3 5315
3, 5268
.0047

10.1

3364
.3026

$\bar{2}$
3.5268
$\bar{1}$.4808
1.0076

.0257
4
.1028

.0257
9
.2313

.0257
16
.1642
257
4212

.0257
25
1285
514
6425

0257
36
1542
771
9252

0257
49

$\bar{2}$.4102
1.6902
.1004

0257
64

4102
8062
1.2164

0257

4102
9542
9542
3186

4102
0414
0414
4930 =

4102
0792
0792
5686

4102
1139
1139
6380

4102
1461
1461
7024

See page 165

Line to factory

2 Ohms

.0106) 1.0000 (~~[illegible]~~ lbs to ohm
5328
700
636
640
636

~~1143.2 lbs to~~ 2 Ohms

1132 lbs .2 Ohms

~~10 to 1 — 20 Ohm~~

0.5
~~2775~~
~~87 lamps~~

2
600
6000

1500
150

181

181
16
1086
181
2896

2900

120) 150 (1.25
120
300
240
600

300
22
660

1.25
.125

.125) 2000 (16
125
750
750

~~1500~~

20
~~600~~

2000
.06
18000

4000
.22
8800

Line To Factory

2 ohms

1 Ohm No 10 wire
weighs 90.6 lbs

.0106) 1.0000 (90.6
954
600

181 lbs in 2 ohms

1200 lamps per day
2 hours on pumps
5 lamps per pump

240 lamps at 20 candles
6 per H.P
~~[illegible]~~ H.P.
120 lamp at a time
20 H.P

340 mils 1 ft long

sp. g. Cu = 8.9

.000340	$\bar{4}$.5315
3.14	0.4969
Comp 4	9.3979
12	1.0792
8.9	0.9494
50	1.6990
	.1539
.03612	$\bar{2}$.5575
[illegible]	
	$\bar{2}$.7144
.0514	O.K.

1000. feet No 10 wire
weighs 54. lbs.

~~225~~ 54
250
4 wires in & out
for 54 lbs.

30
$ 16.20

24 wires

16.20
6
$ 96.20

3 100 light

1450
4
5800

17956) 580000 (30 wires
84
58000

18

59 light

158 feet

4
7

2100
4
8400
60
504000

1790) 50400 30 10 wires

E 60 Lamps

1400
4
5600
80
18 / 336 000 (20 No 10 wires

B 32

1000
4
4000
32
128.000

D

189 Ohms

.5½ mg

1½

12 feet

75

10

15 15

~~10~~ 15

50 feet high

10 lamps

99

500
100

17) 50000 (3 wires

6 wires

9 wires

152,680.00 / 852,288.75 / 5
763,400.00
8883825

Hamilton

4

1 Dining Room

3.5
8.
28.0
16
44 feet

~~4.5~~
2

Day 50

25

680
2
1360
25
6800
2720
34000

2 No. 10 wires
1 No 6 wire

See page 272 for calcu.

Total
~~160~~
200 feet No. 16 wire in entry

16,620 mills in 1A

3rd Story Line A

To ~~1A~~ 10 lamps

In hall 6, Rooms 2

Distance from Basement

$$\begin{array}{r} 20 \\ 15 \\ 15 \\ \hline 45 \text{ feet} \end{array}$$

To hall lamps

Average 56 feet

101 feet to hall

~~1300~~

$$\begin{array}{r} 1360 \\ 2 \\ \hline 2720 \\ 6 \\ \hline 16620 \end{array}$$

1 No 10 wire
for 6 Hall lamps.

200 feet No. 22 wire

2720 mills in A

16620
2720
19,340

40 feet No. 10 wire down

Line A 3rd floor

4 lamps in rooms
25 feet average
separate line

340
2
680
4
2720

Line A 2nd Story

26 lamps
20 in hall
6 in chamber

56 feet
30
86 feet in hall

See page 213

Entry

200 ~~150~~ feet No. 6 wire

40,800

100 feet No. 17 wire

9000 mills through A

A line 2nd Story

75 feet

1020 mills
2 ½ pounder
2040
20
40800

[illegible] 880

[illegible]

6 in Chambers

25 feet

3 line

average 25
30
55 feet

750
2
1500
6
9000

3000 mills

see page 215

~~150~~ 200 feet No. 6 wire

40,800 mills

100 feet No. 10 wire

23.200 mills
2
46 400

page 216

A line 1st floor

Nov 1880

60 Lamps

Hall 20 lights

56 feet out
20 from basement
76

1020
2
2040
20
40,800

Drawing room

40 lights 2 lines

30
25
55

580
2
1160
20
23200 2

A

30 feet No. 10

30 feet 4 No. 10 wires

40 feet 8 No 10 wires

In Basement

~~[illegible] wires~~

A line

Nov 1880

2nd to 3

16.620
2.720
19,340 mills
40 800
9000
pt 6 2nd
69,190
40.800
46,400
17,958) 156,340 (8

100 feet No. 16 wire

8000 mills
30 feet No. 14 down

50 feet No. 18 wire
75 feet No 15 wire

6000 mills down
8000
14000 30 feet No. 11

B line

Nov 1880

3rd floor 4 lamps FRU

25
45
70

1000
2
2000
4
8000

Two circuits 4000

2nd floor 5 lamps

aver 25
30
55

700
2
1400
2
2800
42
6000

175
~~100~~ feet No.12 wire

27200
14000
41200 down
40 feet No = 6

B line
1st floor
20 lamps.

FRU
Nov 18 80

30 feet
20
50

680
2
1360
10
13600
13600
27200

C line

Same as B

Nov 4 1880

D same as B

50 feet No. 19

[illegible] [illegible]

3200 down

30 feet No. 17

~~75 feet No 22~~

60 feet No. 19

30 feet
No. 14

$$\begin{array}{r} 4080 \\ 3200 \\ \hline 7280 \end{array}$$

Nov 1880

E Line

3rd floor

2 lamps

$$\begin{array}{r} 20 \\ 45 \\ \hline 65 \end{array}$$

$$\begin{array}{r} 800 \\ 2 \\ \hline 1600 \end{array}$$

2nd

50 feet

$$\begin{array}{r} 680 \\ 2 \\ \hline 1360 \\ 3 \\ \hline 4080 \end{array}$$

100 feet 2 No 10
Or 100 feet No 6

40 feet
68000
7280
18) 75280 (4

4 No 10 wires

Σ First floor
50 lights Nov 1880

3.5
8
28.0

20 feet to ceiling
28 feet

50 feet to go

680
2
1360
25 on side
6800
2720
34000
2 sides
68000 mills down

150 feet No. 16 wire

30 feet No. 12 wire

11424 mills.

~~Parl~~ 100 feet No. 13

19040 mills down

F 3rd floor

8 lamps

Aug, 22, 1890

25 feet
45
70

952
2
1904
~~2 circuits~~
3808
3 circuits
11424

2end floor
Parlor
1 circuit

32 lights

25 feet
50
75

952
2
1904
5
9520
2
19040

50 feet No 20

1360

100

~~75~~ feet 2 no. 10

or no. 6

32646
1360
19040
11424
18) 64470

4 No 10 wires
30 feet

---

7 2 in bedroom

Nov. 22 1880,

~~30 feet~~
25 feet

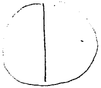
340
2
680
2
1360

20 in conservatory

32
30
62

816
2
1632
20
32640

1000000



G

Jan, 22 1881

~~Curr~~

100 lamps from top of building ~~75~~

30
20
110

160

2176
100

18 | 217.6 00 | 12 No. 10 wires
18
37

back to street

Distributing
100 feet is 065

$\bar{6}.4808$
108,800 5.0374
40 1.6021
2 .3010
26.3 lbs 1.4213

$\bar{6}.4808$
60,928 4.7860
1.8451
.3010
30. lbs 1.4129

$\bar{6}.4808$
4.7267 53.312
1.8451
.3010
1.3536 22.5 lbs

Basement

A 100 lamps 40 feet
Nov. 22, 1880

544
2
1088
100
108,800

B 32 lamps 70 feet

952
2
1904
32
3808
5712
60,928 mills

C 28 lamps 70 feet

952
2
1904
28
15232
3808
53,312

$\bar{6}.4808$
82824 4.9180
104 2.0170
0.3010
1.7168
52.1 lbs

$\bar{1}.4808$
165648 5.2261
104 2.0170
2 0.3010
2.0189
104 lbs

D 104 feet 29 lamps
Nov 22 1880

1428
2
2856
29
25704
5712
82,824 mills

E 58 lamps
104 feet

2856
58
22848
14280
165,648

.00000 3026 $\bar{6}.4808$
217600 5.3385
156 2.1987
2.0180
3010
208 lbs 2.3190

~~Total Wts~~ —
6.4808
474,368 5.4760
2.0414
3010
200 lbs 2.2992

F. 59 Lamps
158 feet Nov 22 1880

2176
2
4352
59
39168
21760
256,768

G 217,600 mils 100 lamps
110 feet

217.600
256.768
474,368

1,163 ⌊.0657
.0328

1.08" diameter

Weight in basement

Nov 22 1880

26.3
30
22.5
52.1
104.
208.
200.

642.9 lbs. of Cu. in Basement

Σ 474,368
217 600
165 648
82 824
53 312
60 928
108 800

1,163,480

from page 178
Line A

$\bar{6}.4808$
4.2200   16,620.
1.9542
2.6560

4.5 lbs
4
18.0 lbs

16,620
8,215
4,107

Put 16.620 r
4
66480 mills to top A
200 feet
Then No:16 wire in entry

.054
.06

---

from page 182
Line A

Nov 22nd

$\bar{6}.4808$
4.6107   40.800
70 1.8451
.9366   8.64 lbs

4 | 40800   200 feet No. 12 wire
10.200

40,800
4
163200 mills

8.64
4
34.56 lbs

At Vanderbilts house
Nov 2

40800
10200

200 feet No. 12

$\bar{6}.4808$
4.6107
1 60 = 1
.6936

4.94
4
19.76 lbs

40800
4
163200

from page 184

Line A

11.600

$\bar{6}.4806$

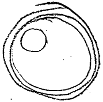
1.6665 46400

1.6021 40

.7794

$$\begin{array}{r} 5.61 \\ 2 \\ \hline 11.22 \end{array}$$

$$\begin{array}{r} 46.400 \\ 2 \\ \hline 92800 \end{array}$$



Line A summary

Vanderbilts House

Nov, 2 7

Hall 3rd

200 feet ~~No. 16~~ = 0".065

Chamber 3rd

200 feet ~~No. 22~~ = 0".03

Hall 2nd

200 feet ~~No. 12~~ = 0".100

Chamber 2nd

~~1~~00 feet 0".050

Hall 1st

200 feet 0".100

100 feet 0.100

To run to lamps in fixtures

100 lamps 6 feet each

600 × 2 = 1200 feet 0".030

Line A

~~[illegible]~~ I propose to put in one paper 50000 mills of Cu.

In the other as much as possible

66.480
2720
163 200
163 200
92 800
488400

$\bar{6}.48048$
5.6990
7.9542
2.1340 136 lbs.
~~.3010~~ ~~272~~
~~1.4350~~

12000
.3
36.00
$ 360

Vanderbilt's Line

Nov. 22

Line B Total

Chamber 3rd floor

100 feet 0".065

Chamber 2nd floor

50 feet 0".065

100 feet 0".050

Parlor

175 feet 0".1   60 feet ~~0".15~~ 2

40 feet 0". ~~15~~ 2

100

32 lamps

Lines C & D same as B

[illegible]

Line E / Total

Vanderbilt's house

Nov 22

50 feet 0".05

60 feet 0".05

Dining ~~room~~

125 feet 0".2

30 feet 0".065

30 feet 0".1

4 no 10 wires 40 feet

75250 mills

F lines Vanderbilt house

Nov 22

150 feet 0".065

100 feet 0".1 30 0".1

50 feet 0".03 70 0".2

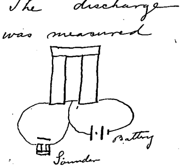
100 feet 0".2

G

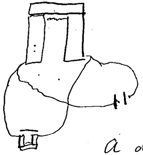
100 .065"

March 12, 1879.
: Book 1 Page 121

The discharge from a magnet was measured



A click could be heard when the current was Taken off.



a double click could be heard

A duplex point was used to break the main circuit and the discharge thrown the sounder Results when no armature was on the magnet the discharge was stronger, sharper and of shorter duration than when the armature was on

Book 1 Page 137

Tests of the power that could be turned

Batchelor 10.963 ft. lbs
20 seconds

Francis 16.146 ft. lbs
10 seconds 15.225

Martin 14,100 ft. lbs
20 seconds

Geo. Carman
14,106 ft- lbs
20. seconds

Albert Swanson
17,191
15.750.

Kruesi 15750
14.445

Book 1 Page 245

If an armature has 10 lbs. of Cu on it and a resistance of 1 Ohm with 100 convolutions

If	10 Ohms	316 convo
	5 "	223 "
	4 "	200 "
	2 "	141 "
	1 "	100 "
	1/2 "	71 "
	1/3 "	59.7 "
	1/4 "	50 "
	1/9 "	33 "
	1/16 "	25 "
	1/25 "	20 "

Book 6 Page 40

The combustion of a cu. ft. of common gas will heat 65 gallons of H_2O 1° Fahr.

Haswell

1 Gall = 8.32 lbs.

8.32
65
4160
4992
540.80
5
2764.00
772

33000
60
1.980000

1,980,000)2,087,488(1.07

2,087.488 ft lbs

1 Gas burner burning 5 cu. ft an hour gives off a little more heat than is required to run a horse power for an hour.

Estimates for rewinding - Dec 6 1880

The small cast iron motor which gave 32.6 Volts at 1640 revolutions per minute from six turns in a division

It can be run with safety 2500 r. p. m.

1640 : 2500 :: 32.6 :

2500

163000

652

16.40) 815 ~~0000~~ (~~4~~ 9

6560

1590

49 Volts

Say 50

The most that will ever be needed for any lamps will be 150 Volts and this can be obtained at 2500 r.p.m

3 X 6 turns in each section

18 turns

.045
.01[illegible]
56

Dec 24

Armature 37 Coils

⊘ 5" diameter

$$\begin{array}{r} 3.14 \\ 5 \\ \hline \end{array} \qquad \begin{array}{r} 3.7 \\ 2 \\ \hline 7.4 \end{array}$$

$$74\,)\,15.70\,(\,.21$$

$$\begin{array}{r} 148 \\ \hline 90 \end{array}$$

0".21 for space

$$\begin{array}{r} 18 \\ \hline 60 \end{array} \qquad \begin{array}{c} 5 \\ 3 \end{array}$$

To be wound with .021 fine

$$\cancel{1/0} \quad 4 \times \frac{20}{6} = \frac{40}{3} = 13.3$$

$$\begin{array}{r} 13.3 \\ .6.1 \\ \hline 133 \\ 798 \\ \hline 9.113 \end{array}$$

9.1 Ohms

Magnet 6" iron

wire 049
.011
.060
6
.36

30
70
2100

40 minute
60
240

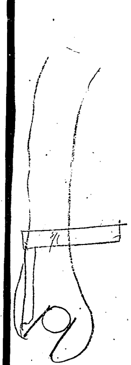
46
70
3020 feet

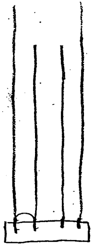
14.6) 70 (5

5 lbs. of wire

Dec 6 1880 FRU

Arrangement for testing Lamps at Factory





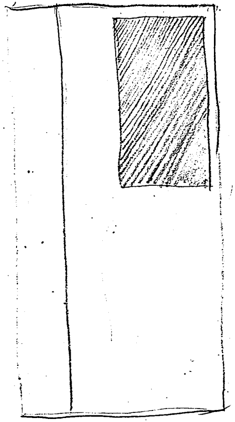
$$C = \frac{\mathcal{E}}{R+r}$$

$\mathcal{E} =$ Constant

$$C = \frac{\mathcal{E}}{R+r}$$

$$R+r = \frac{\mathcal{E}}{C}$$

$C =$ 1 Weber



The machine can only run the lamp to be tested. For if it has its field to run, the current to the field will interfere with that to the lamp.

Let C_e = current to lamp
C_m = " " magnet

Drop in machine

$$= \mathcal{E}_a = (C_e + C_m) R_a$$

$$C_e R_e = \mathcal{E}_e = \mathcal{E} - \mathcal{E}_a$$

$$C_m R_m = \mathcal{E}_m = \mathcal{E} - \mathcal{E}_a$$

$$C_e R_e = C_m R_m$$

The magnets from the machines must be fed from main line to factory;

For a standard light

Candles standard are the best but very expensive. a Carcel oil lamp would also be very good

I think a kerosene oil lamp using rather a light oil ~~with a reservoir fed by a~~ siphon the same as a student lamp so as to keep a constant height of oil. A student lamp would do.

This could be standardized to candles at intervals so as to give eight candles or any given number — — — — —

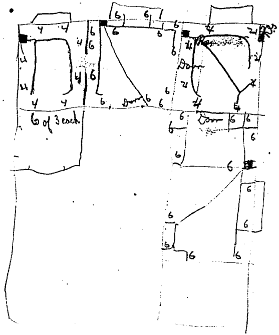
There will be a double switch so as to put the machine either on a resistance or on the lamp which is to be tested. The machine will be run at 2000 r.p.m. and the connection made through the Electro Dynamometer ~~so as to give a certain deflection~~ and the deflection read. The magnet is adjusted until

The deflection is brought to a standard amount which will have been calculated to follow from having ~~[illegible] volts~~ 140 Volts on the line

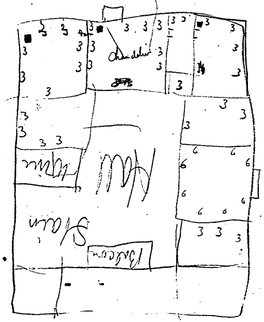
1st floor
5th Ave

13
78

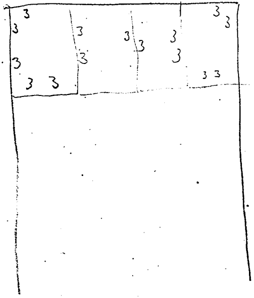
51st St


4
4
4
4
4
4
4
4
6 of 3 each
6
6
6
6
6
6
Door
Door
Door
6
6
6
6
6
6
6
6
6
6

If 2nd floor — for room underneath 50 lights


Chandelier
Stair
Hall
Stair
Balcon

3rd Floor


3
3
3
3 3
3
3
3
3
3
3
3
3
3
3 3

6889 mills in No 14 wire

A line omitting all lights to the hall

Third floor 9 lights

3 lights 16 feet

204
3
612 mills X 3 = 1836

3 light 16 feet

612 mills X 3 = 1836

3 lights 8 feet

Down 153 mills X = 459

9 lights 35 feet through pipes

476
9
4284
3
12852

2 No 14 wires
1 No 12 wire

A line second story

18 lights 20 feet

```
  272
   20
 5440
    3
16320
```

1 No 10 wire for second story

A line 1st story

12 light 50 feet

```
 680
  12
1360
680
8160.
```

O K

9 lights 35 feet ++

476
9
4284
12 lights 11424
15708
Down
No. 10 wire

B line 2nd Floor

Floor 24 feet 6 lights

340
6
2140
3
6420 No 14 wire

Down ~~12 76~~ 12 feet 6 lights
~~35 feet~~
12 lights

3/2 the Cu
476
12
952
476
5712
2856
8568
~~[illegible]~~ 2856
11424
~~No. 12 wire~~

B line 2end Floor

12 lights
Down
20 feet

$$\begin{array}{r} 272 \\ \underline{12} \\ 544 \\ \underline{272} \\ 3264 \end{array}$$

No. 14 wire

B line 1st floor

O. K
carry wires to Basement

C line 3rd same as B

Down No. 12 wire

2end Floor
21 lights 20 feet

$$\begin{array}{r} 272 \\ 20 \\ \hline 5440 \\ 3 \\ \hline 16320 \end{array}$$

No 16 wire

1st O.K

D line

Third floor

10 lights

35 feet

4765
3
13295

Down

No. 11

12 lights Second story

20 feet

272
12
544
272
3264
3
9792

No. 12 wire

pat O.K.

E. Line

15 lights 3rd. Floor

35 feet

```
  476
   15
 2380
 476
 7140
    3
21420
```

Down

No. 16 wire

40 lights 2nd Floor

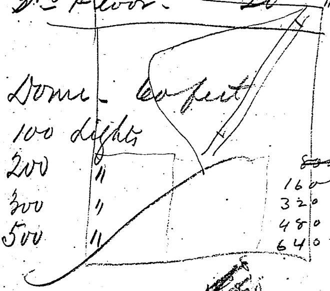
20 feet

```
  272
   40
10880
    3
32640
```

2 No. 10 wires

1st O.K

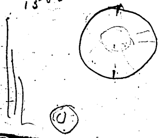
1st Floor — 50 lights
2nd Floor — 20 "
3rd Floor — 20 "



Dome — Perfect
100 lights
200 "
300 "
500 "

800
~~80000~~
160000
320000
480000
640000

300
50
15000



3 No 5 for each
100 lights

Summary =

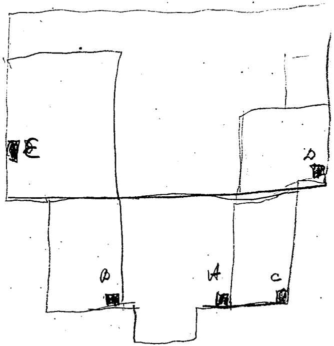
Line A
9 lights From 3rd down 1 No. 12 wire
clear through 9 lights
From 2nd down 1 No. 10 ~~wire~~
18 lights • ~~3 wires~~ 4 wires

Line B
From 3rd down 1 No. 10 ——
clear to basement 17 lights
From 2nd down 1 No. 14 ——
12 lights

Line C
From 3rd down 1 No 10 ——
17 lights
—— 2nd —— 1 No. 10 ——
21 lights

Line D
From 3rd down 1 No. 12 ——
10 lights
" 2nd " 1 No. 12 ——
12 lights

Line E
From 3rd down 1 No. 10 ——
15 lights
From 2nd " 2 No 10 ——
40 lights


E
D
B
A
C

120.
3
360
60
420.
5
2100.

75–c
17
92–

11) ~~5000~~
398. (36
33
68
66
2

1.50,

10c lar per Ton
7 c Ammonia Liqr ~

12) 22000 (1833.
12
100
96
40
36
40.

4800.	Engine
1833 –	Wire.
2500	Piping Paying
2100	Boilers –
550	Feedwater pump
300	Piping –
800	Flooring Structure,
400	Blower-Bunker.
250	Station apparatus,
260	Stock & selling.
13783.	

7

3 5000.

120
12
240
120
1440
1520
1

21
12
42
21
252.00

~~[illegible]~~

120
8
960. Lights

4 lbs per hp – 120
4
480 – hours
5
2400.

5000.

Meters 100 – 500

Investment 13783.
960. Lights –

ton coal per hours
~~5 [illegible]~~
~~at 3~~ —— $8 – per 5 hours

Engineer	3
Oil water	0.50
	18 50
8 Lamps.	2.80
Dep	1.50.
Rent	1.50.
Taxes Ins.	25.
	2455
	1200
	1255

Dep. 4 p.c. or
520 per year – or 1.5 c per night

13
40
520.

d
365
5 h
1825 hil
9600
17,520,000
43,800

HP
1200
8
9600

61320 ~~000~~ Cu ft gas
1,50 per M
3066000
61320
91,980,00

91980
46802
45178

Ap 15. 188[illegible]

170,680.

45,178 00 (26 ~~76~~
341360
1104200
1024080

76
20
320

76 / 1255 (14
76
~~[illegible]~~
365
304
61

76

76
16
456
76
121

960
16
5760
960
15,360
5
76,800

76
50
3800